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Mortality Trends from Ischemic Heart Disease in Turkey: 2009-2019

Türkiye İskemik Kalp Hastalığı Mortalite Trendi: 2009–2019

ABSTRACT

Objective: Cardiovascular diseases still play an important role in public health and epidemiology as the leading cause of death worldwide. Ischemic heart disease is the most common reason in this group. This study aims to analyze the latest trends in ischemic heart disease mortality rates in Turkey by age, gender, and region using the Turkish Statistical Institute mortality data and evaluate the results.

Methods: We have obtained ischemic heart disease mortality data (2009-2019, in 12 regions) for Turkey from the mortality database of the Turkish Statistical Institute. Joinpoint analysis was used to estimate the annual percentage change and average annual percentage change to identify significant changes in trends.

Results: The mean mortality rate for ischemic heart disease in Turkey was in an increasing trend from 2009 to 2019 (annual percentage change=1.7 (−0.8; 4.3), *P*=.166). This increase was more pronounced in women (annual percentage change=2.2 (−0.7; 5.2), *P*=.121) compared to men (annual percentage change=1.4 (−1.1; 3.9), *P*=.235). When the period between 2015 and 2019 was evaluated, it was determined that ischemic heart disease mortality was in a decreasing trend in the groups over 65 years of age. The death rate due to ischemic heart disease is almost 2 times higher in men than in women in Turkey, and this rate ratio is highest in the Istanbul region.

Conclusion: Although ischemic heart disease mortality trends have decreased globally, our country's average is still on an increasing trend. However, significant decreases have been observed in ischemic heart disease mortality rates, especially in the group over 65 years of age, in the last 5 years.

Keywords: Ischemic heart disease, epidemiology, Turkey, mortality, cardiovascular diseases

ÖZET

Amaç: Kardiyovasküler hastalıklar dünya çapında önde gelen ölüm nedeni olarak halk sağlığı ve epidemiyolojisinde hala önemli bir rol oynamaktadır. Bu grupta en sık neden iskemik kalp hastalığıdır (İKH). Bu çalışma, Türkiye İstatistik Kurumu (TÜİK) ölüm verilerini kullanarak Türkiye'deki İKH ölüm oranlarındaki son eğilimleri yaşa, cinsiyete ve bölgeye göre analiz etmeyi ve sonuçları değerlendirmeyi amaçlamaktadır.

Yöntemler: TÜİK ölüm veri tabanından İKH ölüm ve nüfus verileri (2009-2019 arasında, 12 bölge olarak) elde edildi. Trendlerdeki önemli değişiklikleri belirlemek için Joinpoint analizi kullanıldı ve yıllık yüzde değişim (APC), ortalama yıllık yüzde değişim (AAPC) oranları belirlendi.

Bulgular: Türkiye'de İKH için ortalama ölüm oranı 2009'dan 2019'a kadar artan bir eğilim içindeydi (APC=1,7 (−0,8; 4,3), *P*=,166). Bu artış kadınlarda (APC=2,2 (−0,7; 5,2), *P*=,121) erkeklere göre (APC=1,4 (−1,1; 3,9), *P*=,235) daha belirgindi. 2015-2019 dönemi değerlendirildiğinde 65 yaş üstü gruplarda İKH mortalitesinin azalma eğiliminde olduğu belirlendi. Ayrıca, ülkemizde İKH nedeniyle halen erkeklerde kadınlara göre yaklaşık 2 kat daha fazla ölüm hızı olduğu ve bu oranın İstanbul bölgesinde en yüksek olduğu görülmektedir.

Sonuç: İKH ölüm eğilimleri küresel olarak azalmasına rağmen, ülkemiz ortalaması hala artış eğilimindedir. Ancak son 5 yılda özellikle 65 yaş üstü grupta İKH ölüm oranlarında önemli düşüşler gözlenmiştir.

Anahtar Kelimeler: İskemik kalp hastalığı, epidemiyoloji, Türkiye, ölüm, kardiyovasküler hastalıklar

ORIGINAL ARTICLE
KLİNİK ÇALIŞMA

Zafer Yalım, M.D.[1]
Nurhan Doğan, M.D.[2]
Sümeyra Alan Yalım, M.D.[3]

[1]*Department of Cardiology, Afyonkarahisar Health Sciences University School of Medicine, Afyonkarahisar, Turkey*
[2]*Department of Biostatistics and Medical Informatics, Afyonkarahisar Health Sciences University School of Medicine, Afyonkarahisar, Turkey*
[3]*Division of Immunology and Allergy, Department of Internal Diseases, Kırıkkale University School of Medicine, Kırıkkale, Turkey*

Corresponding author:
Zafer Yalım
✉ zaferyalm@yahoo.com.tr

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Cardiovascular diseases (CVD) still play an important role in public health and epidemiology as the leading cause of death worldwide. Ischemic heart disease (IHD) is the most common reason in this group, responsible for 16% of the world's total deaths.[1] In many different studies conducted in Europe and America, significant differences have been reported in the mortality rate of CVD, both regionally and in terms of diseases. It is known that the level of development of countries, lifestyle variations, aging of the population, and alteration of CVD main risk factors (stress, hypertension, diabetes, obesity, etc.) have important effects on these differences.[2,3]

Joinpoint regression analysis is the most frequently utilized analysis among the statistical methods to determine the significant changes and breakpoints in the mortality trend over time.[4] Although a general decreasing trend was observed in IHD mortality between 1980 and 2009 among European Union member states, it was observed that there were still significant differences between countries.[2] In another Joinpoint regression analysis conducted in the United Kingdom, it was reported that CVD decreased at a faster rate than cancer between 1983 and 2013, and the age-standardized death rate for cancer in 2011 exceeded CVD in both sexes.[5] In another study evaluating the data of 188 countries, there were revealing differentiations in cardiovascular mortality by income level of countries. While there was a positive relationship between income level and IHD mortality until 1990, this relationship was reversed between 1990 and 2010 in high-income countries and a decrease in IHD mortality was detected worldwide.[6] Although age-adjusted IHD mortality trends are regressing globally, the absolute number of IHD deaths is still increasing, in part due to population growth and aging, as well as changes in lifestyle and food systems.

These differences in mortality provide important evidence of changes in health policy and resource allocation for each country and region. In our country, there is no study evaluating the mortality trend for IHD, which is still the most common cause of death. The objective of this study is to analyze the latest trends in IHD mortality rates in Turkey by age, gender, and region using Turkish Statistical Institute (TUIK) mortality data and to evaluate the results.

Methods

Data Source

We have obtained IHD mortality data for Turkey from the mortality database of the TUIK.[7] The underlying cause of death from IHD was determined using the I20-I25 codes of the International Classification of Diseases (ICD), the 10th revision. Data available for each year in 5-year age groups up to 85+ years for IHD death data (2009-2019) in the 12 regions were grouped by year, gender, and age. The results are not shown for the subgroups aged <35 years because of the small number of deaths that occurred.

Data taken from TUIK is based on the death notification system and previous data created by the Ministry of Health, General Directorate of Public Health. Ischemic heart disease death data were obtained by requesting an official petition from the relevant institution and did not impose any restrictions on information sharing and analysis. This study was conducted with ethical approval.

Statistical Analysis

We obtained population estimates for Turkey from the TUIK website. Age- and sex-specific and age-standardized rates (ASRs, using the World standard population and the method of direct standardization) were calculated.[8] Rates were expressed as deaths per 100 000 persons. The ASRs remove the effects of historical events on age structure and control for differences in age structure in populations. Age-specific mortality rates were calculated by 5-year periods (0-4, 5-9, 10-14, ..., 75-79, 80-84, and ≥85 years) for the age interval from 0 to 85 and over. This methodology was repeated within each region. For each region, ASRs and age- and sex-specific IHD mortality rates were analyzed using joinpoint regression to identify years at which changes in trends occurred. The method is widely used in epidemiological studies such as incidence and mortality. Mortality trends from IHD were assessed using the Joinpoint regression analysis proposed by Kim et al.[9] Joinpoint regression analysis identifies the best fit for inflection points ("joinpoints") at which there is a significant change in trends and estimates the magnitude of trend changes (increases or decreases) for each period.

Results include the years (period) making up each trend, as well as the annual percentage change (APC), average annual percentage change (AAPC), and 95% CIs for each trend.[9-11] The difference between males and females was determined with the parallelism test.[12] Statistical analysis was carried out with the National Institutes of Health National Cancer Institute Surveillance Research Program Division of Cancer Control and Population Sciences 9609 Medical Center Drive Bethesda, MD 20892. We considered *P* values less than .05 to be statistically significant.

Classification of Regions

Nomenclature of Territorial Units for Statistics definitions are produced in order to collect and develop regional data, to provide analysis of the socio-economic structure of the regions, to establish regional policies, and to establish a comparable database with the European Union Regional Statistical System. Figure 1 shows the 12 regions of Turkey—(TR1-Istanbul: Istanbul; TR2-Western Marmara: Balıkesir, Canakkale, Edirne, Kırklareli, Tekirdağ; TR3-Ege: Afyon, Aydin, Denizli, Izmir, Kutahya, Manisa, Mugla, Usak; TR4-Eastern Marmara: Bursa, Eskisehir, Bilecik, Kocaeli, Sakarya, Duzce, Bolu, Yalova; TR5-Western Anadolu: Ankara, Konya, Karaman; TR6-Akdeniz: Adana, Antalya, Burdur, Hatay, Isparta, Mersin (İcel), Kahramanmaras, Osmaniye; TR7-Central Anadolu: Kirikkale, Aksaray, Nigde, Nevsehir, Kırsehir, Kayseri, Sivas, Yozgat; TR8-Western Karadeniz: Zonguldak,

ABBREVIATIONS

AAPC	Average annual percentage change
APC	Annual percentage change
ASRs	Age-standardized rates
CVD	Cardiovascular diseases
ICD	International Statistical Classification of Diseases
IHD	Ischemic heart disease
TUIK	Turkish Statistical Institute

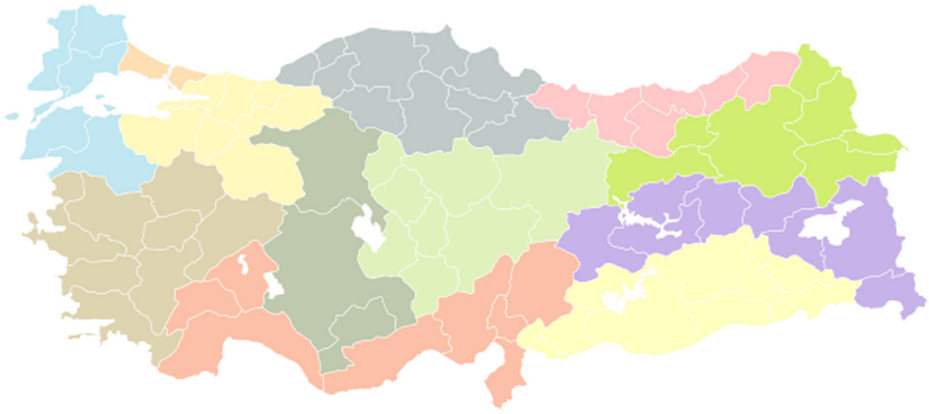

Figure 1. The 12 major regions of Turkey.

Karabuk, Bartin, Kastamonu, Cankırı, Sinop, Samsun, Tokat, Corum, Amasya; TR9-Eastern Karadeniz: Trabzon, Ordu, Giresun, Rize, Artvin, Gumushane; TR10-Northeastern Anadolu: Erzurum, Erzincan, Bayburt, Agri, Kars, Igdir, Ardahan; TR11-Central Eastern Anadolu: Malatya, Elazig, Bingol, Tunceli, Van, Mus, Bitlis, Hakkari; TR12-Southeastern Anadolu: Gaziantep, Adiyaman, Kilis, Sanliurfa, Diyarbakir, Mardin, Batman, Sirnak, Siirt).

Results

The mean mortality rate adjusted for general age (according to the world standard population) for IHD in Turkey showed an increasing trend from 2009 to 2019, but this increase was statistically nonsignificant (APC=1.7 (−0.8; 4.3), *P*=.166). While the APC value of the general population in the 2009-2019 period was 1.7 (−0.8; 4.3, *P*=.166), the APC value of women (2.2 [−0.7; 5.2, *P*=.121]) was higher compared to men (1.4 [−1.1; 3.9, *P*=.235]). There were significant periodic differences in this increasing trend, especially in 2015, and afterward, it was remarkable that ASR tended to decrease for both genders (Figure 2).

Mortality rates with the diagnosis of IHD and age-standardized rates between 2009 and 2019 are presented in Table 1. According to our results, the IHD mortality rate in our country is approximately 2 times higher in men than in women, and this rate is even higher in the Istanbul region.

In addition, IHD annual mortality changes (APC) and 10-year mean changes (AAPC) by regions are presented in Tables 2 and 3 for both genders. Between 2009 and 2015, breakout increase was detected in TR3-TR4-TR12 region (APC: 8.9 (2.3; 15.9), *P*=.016), (APC: 5.2 (0.4; 10.1), *P*=.036), (APC: 4.4 (1.5; 7.3), *P*=.01) in men. Also, there was a regular significant increase in the TR2 region (AAPC: 3.5 (0.8; 6.3), *P*=.017).

In women, it was observed that the AAPC increased significantly, especially in the TR2 (AAPC: 4.7 (1.5; 8.0), *P*=.008) and TR6 region (AAPC: 2.7 (0.0; 5.5), *P*=.047). In addition, there was a significant increase in the TR3 region between 2009 and 2015 (APC: 10.6 (3.2; 18.6), *P*=.012). Also increases in the TR8 region (APC: 6.0 (−0.0; 12.4), *P*=.051) and in the TR9 region (APC: 8.1 (−0.5; 17.5), *P*=.061) were observed between 2009 and 2016.

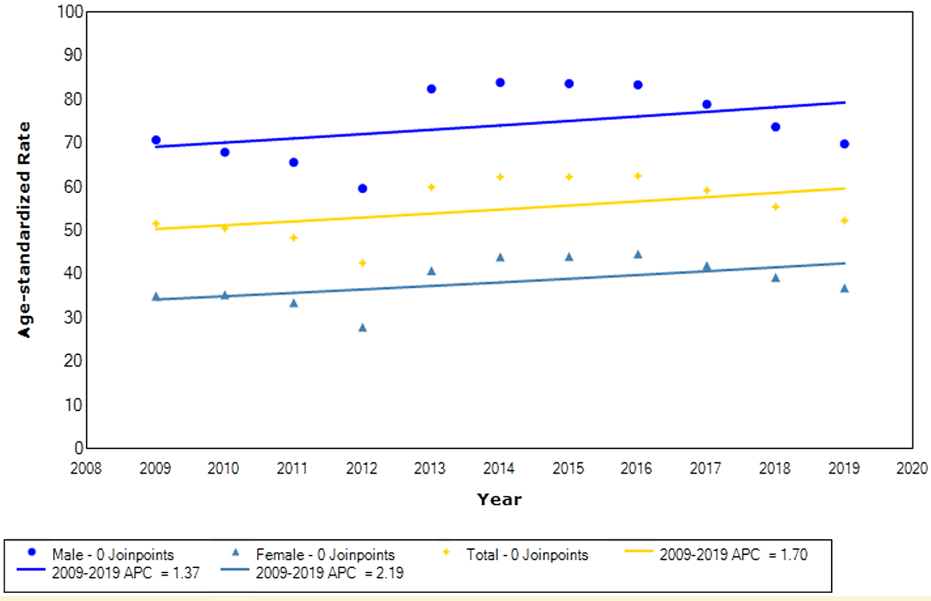

Figure 2. Trends in mortality from ischemic heart diseases in Turkey, by genders, 2009-2019.

Table 1. Number of Deaths, Distribution of Standardized Mortality Rates by Gender

Region	Deaths			ASR			Male/Female Ratio
	Male	Female	Total	Male	Female	Total	
TR1	48 836	32 889	81 725	74.37	34.41	52.48	2.61
TR2	23 078	17 213	40 291	82.07	42.82	61.55	1.92
TR3	59 657	46 671	106 328	80.33	42.86	60.45	1.87
TR4	38 078	27 273	65 351	83.67	43.46	62.30	1.93
TR5	30 576	22 425	53 001	71.82	36.73	52.77	1.96
TR6	42 974	31 690	74 664	76.40	42.52	58.58	1.80
TR7	19 979	14 717	34 696	79.13	41.39	58.71	1.91
TR8	27 824	20 520	48 344	73.81	37.89	54.63	1.95
TR9	13 966	10 034	24 000	65.20	28.57	45.44	2.28
TR10	7925	5709	13 634	69.64	36.78	52.13	1.89
TR11	10 986	8061	19 047	66.94	34.99	49.62	1.91
TR12	19 178	15 193	34 371	71.22	39.76	53.89	1.79
Total	343 057	252 395	595 452	74.55	38.51	55.21	1.95

ASR, age-standardized rate.

Table 2. The Annual Rate of Ischemic Heart Disease Mortality Between 2009 and 2019 in Men

		Period I		Period II	
	AAPC (95% CI) (2009-2019)	Years	APC (95% CI)	Years	APC (95% CI)
TR1	−1.5 (−4.6; 1.7) (*P*=.347)	2009-2016	1.6 (−1.7; 5.1) (*P*=.281)	2016-2019	−8.5 (−17.7; 1.8) (*P*=.087)
TR2	3.5 (0.8; 6.3) (*P*=.017)				
TR3	3.7 (−0.6; 8.3) (*P*=.094)	2009-2015	8.9 (2.3; 15.9) (*P*=.016)	2015-2019	−3.6 (−12.3; 6.1) (*P*=.388)
TR4	1.5 (−1.8; 4.9) (*P*=.365)	2009-2015	5.2 (0.4; 10.1) (*P*=.036)	2015-2019	−3.7 (−10.8; 3.9) (*P*=.273)
TR5	−0.3 (−1.6; 1.0) (*P*=.597)				
TR6	1.7 (−0.9; 4.4) (*P*=.169)				
TR7	0.1 (−4.3; 4.8) (*P*=.951)	2009-2014	5.4 (−3.2; 14.8) (*P*=.179)	2014-2019	−4.9 (−11.8; 2.5) (*P*=.154)
TR8	−0.1 (−5.7; 5.9) (*P*=.978)	2009-2017	3.7 (−0.8; 8.4) (*P*=.094)	2017-2019	−37.0 (17.8; −1.2) (*P*=.288)
TR9	0.4 (−4.5; 5.6) (*P*=.861)	2009-2015	6.4 (−0.8; 14.1) (*P*=.074)	2015-2019	−7.8 (−17.9; 3.5) (*P*=.136)
TR10	0.2 (−2.6; 3.0) (*P*=.893)				
TR11	−0.7 (−6.1; 5.0) (*P*=.814)	2009-2016	4.3 (−1.9; 10.9) (*P*=.145)	2016-2019	−11.3 (−26.2; 6.5) (*P*=.160)
TR12	1.2 (−0.8; 3.3) (*P*=.234)	2009-2015	4.4 (1.5; 7.3) (*P*=.010)	2015-2019	−3.2 (−7.8; 1.5) (*P*=.143)

AAPC, average annual percent change; APC, annual percent change.

Table 3. The Annual Rate of Ischemic Heart Disease Mortality Between 2009 and 2019 in Women

	AAPC (95% CI) (2009-2019)	Period I		Period II	
		Years	APC (95% CI)	Years	APC (95% CI)
TR1	−0.4 (−3.1; 2.4) (*P* = .767)				
TR2	4.7 (1.5; 8.0) (*P* = .008)				
TR3	4.3 (−0.5; 9.3) (*P* = .081)	2009-2015	10.6 (3.2; 18.6) (*P* = .012)	2015-2019	−4.5 (−14.0; 5.9) (*P* = .316)
TR4	2.5 (−0.8; 5.9) (*P* = .119)				
TR5	0.4 (−1.8; 2.6) (*P* = .687)				
TR6	2.7 (0.0; 5.5) (*P* = .047)				
TR7	−0.1 (−4.7; 4.7) (*P* = .965)	2009-2015	5.5 (−1.0; 12.4) (*P* = .085)	2015-2019	−7.9 (−17.6; 2.8) (*P* = .117)
TR8	0.8 (−4.6; 6.5) (*P* = .776)	2009-2016	6.0 (−0.0; 12.4) (*P* = .051)	2016-2019	−10.4 (−25.3; 7.4) (*P* = 189)
TR9	0.7 (−5.1; 6.8) (*P* = .825)	2009-2015	8.1 (−0.5; 17.5) (*P* = .061)	2015-2019	−9.6 (−21.2; 3.7) (*P* = .123)
TR10	−0.1 (−2.9; 2.5) (*P* = .965)				
TR11	1.5 (−2.7; 5.9) (*P* = .438)				
TR12	2.2 (0.2; 4.3) **(*P* = .033)**				

AAPC, average annual percent change; APC, annual percent change.

Furthermore, when the 2015-2019 periods were analyzed, the IHD mortality trend was decreasing in TR3, TR7, TR8, and TR9 regions in women (Table 3).

Moreover, individuals were evaluated according to their ages and genders; it was determined that IHD mortality tended to increase in the group aged 75 and over in men, and there was a considerable break between the years 2009 and 2015 in the group aged 75-84. Additionally, IHD mortality tends to increase in the age group over 75 and the age group of 30-44, and there was a significant increase in the group between the ages of 75 and 84 between 2009 and 2016 detected among women. When the period between 2015 and 2019 was evaluated for both gender, it was determined that IHD mortality was in a decreasing trend in the groups over 65 years of age (Table 4).

Discussion

In this study, which evaluated the IHD mortality trend between 2009 and 2019, although a decreasing trend was observed in some periods, especially between 2010-2012 and 2016-2019, there was an increase in the average ASR rates over the age of 35 throughout Turkey. Despite this steady increase, results differed markedly across regional analyses. In addition, when the evaluation period was divided into 2 periods, especially in the last period, APC rates tended to decrease significantly, regardless of gender, age, and regional evaluations. It is predicted that this decreasing trend may be reflected in the IHD mortality results in our country in the following years, and it will be seen as a decreasing trend in ASR rates.

Considering the studies on this subject, although there are differences between nations, it is seen that the IHD mortality trend has decreased significantly in the last 40 years in western countries.[13] In the study by Ford and Capewell,[14] in which individuals over the age of 35 were evaluated in the United States, there was a decrease of 52% in men and 49% in women from 1980 to 2002 in ASR.[14] Another study reported that in the United States the death rate due to IHD decreased from 73% to 56% from 1999 to 2018.[15] Moreover, in European Union countries report, although there are significant differences between regions, decreases were observed in IHD mortality between 1980 and 2009, such that major declines in mortality rates occurred in some countries (Denmark, Malta, the Netherlands, Sweden, and the United Kingdom (AAPCs ≤ 4.0% among men and ≤−3.9% among women between 1980 and 2009), but in some countries (Hungary, Latvia, Lithuania, and Poland), slight decreases, and in Romania (significantly positive AAPC of 1.0%) increases were observed among men in mortality. Furthermore, in the same study, a median AAPC of −2.7% for men and −2.4% for women for all age groups was reported.[16] Contrary to most developed countries, in China, it was reported that IHD-related

Table 4. Annual Percentage Change and Average Annual Percentage Change by Gender and Age Groups (2009-2019)

		Trend 1		Trend 2	
	AAPC (95% CI) (2009-2019)	Period	APC (95% CI)	Period	APC (95% CI)
Male					
30-44	0.2 (−2.5; 2.8) (*P* = .896)				
45-64	0.1 (−1.8; 2.0) (*P* = .886)				
65-74	−0.2 (−3.5; 3.3) (*P* = .923)	2009-2016	3.1 (−0.3; 6.5) (*P* = .067)	2016-2019	−7.3(−17.7; 4.4) (*P* = .170)
75-84	2.5 (−1.6; 6.6) (*P* = .234)	2009-2015	7.9 (2.2; 14.2) (*P* = .015)	2015-2019	−5.2(−13.7; 4.1) (*P* = .211)
85+	5.2 (−0.9; 11.6) (*P* = .097)	2009-2015	11.6 (1.3; 22.9) (*P* = .032)	2015-2019	−3.8 (−14.3; 8.2) (*P* = .453)
Female					
30-44	1.2 (−2.4; 4.9) (*P* = .461)				
45-64	0.6 (−1.9; 3.1) (*P* = .616)				
65-74	−0.9 (−4.8; 3.3) (*P* = .672)	2009-2016	2.5 (−1.6; 6.8) (*P* = .189)	2016-2019	−8.3 (−20.4; 5.5) (*P* = .180)
75-84	1.7 (−3.3; 7.1) (*P* = .512)	2009-2016	6.0 (0.7; 11.5) (*P* = .032)	2016-2019	−7.5 (−22.4; 10.3) (*P* = .318)
85+	5.2 (1.4; 9.1) (*P* = .012)				

AAPC, average annual percent change; APC, annual percent change.

deaths continued to increase in the study evaluating the period from 1987 to 2013.[17] Increasing CVD burden and IHD mortality in low- and middle-income countries such as Turkey are due to the risk factors such as population growth, aging, obesity, insufficient physical activity, high blood lipid levels, lifestyle changes, and tobacco use with the economic transition.[18]

In our country, Dinç et al[19] reported that CVD mortality rate increased by 2.9% in men and 2.0% in women from 1988 to 1994 and then tended to decrease till 2008. In the same study, while a decrease was observed in mortality due to coronary artery disease in men after 1994, it was observed that this decrease in women increased between 2000 and 2005 and then entered a significant downward trend again. It is predicted that all these changes are the reflection of the society's exposure to risk factors in different periods and changes in socio-economic process. Dinç et al suggested that Turkey has completed its epidemiological transition. On the contrary, we think this process is still ongoing because the average APC value of the last 10 years of the period we evaluated was 1.7 and the average was in an increasing trend. However, it was observed that there were significant decreases in APC rates in both men and women especially in the last 5-year period. A new analysis possibly in the next decade could say that this decline could reduce the average 10-year rates. In addition, in the study of Özdemir et al,[20] in which mortality data for the period between 1980 and 2013 were evaluated in our country, mortality rates due to non-communicable chronic diseases continued to increase and drew a plateau between 2010 and 2013. According to these results, it can be said that IHD mortality in our country varies periodically, and new analyses covering a longer period are needed to determine the general trend.

In the Netherland coronary heart disease mortality study, there was a 76% reduction in ASR in both men and women between 1972 and 2007. Besides, attenuation of the decline in CHD mortality among young adults (<55 years) and a subsequent increase in the pace of decline after a period of flattening have been observed.[21] Again, in the study evaluating the mortality of IHD in Austria, that there was an 82% decrease in cardiovascular death rate between 1968 and 2015, while it was reported that the decrease in the 35-54 age group was less than that in the other age groups in the last 20 years.[22] In the United States study between 1979 and 2011, individuals over the age of 25 were evaluated and steady mortality declines were observed over the age of 65 which became even steeper after 2000 (APC; women, −5.0%; men, −4.4%). Although clear decreases were observed under 55 years of age from 1979 until 1989 (women −4.6%, men −5.5%), minimal improvement and stagnation have been observed in all gender since 1989. In particular for women, estimated annual percentage change was found to be 0.1% in 1990-1999 and only −1% after 2000.[13] When these mortality rates were evaluated together with other current data, the fact that a plateau curve has been observed and even increases have been detected in many western societies, especially in under-55 age group, has become a worldwide concern recently.[14,21,23,24] There was a significant downward trend in both men and women in the over-65 age group, especially in the second half of the period we evaluated, while the absence of this

trend in the under-65 age group suggests that this concern is also valid for our country.

In the global IHD mortality trend report between 1990 and 2010, it was stated that there was a positive relationship between the income levels of the countries and mortality in the 1990s; by the following period, significant decreases were observed possibly with the control of cardiovascular risk factors (such as high body mass index, blood pressure, glucose, and cholesterol). In contrast, it has been reported that there is still an increasing trend in high BMI and increased blood glucose-related mortality in low-/middle-income countries.[6] In Onat's[25] study on cardiovascular risk factors about 20 years ago, it was reported that many cardiovascular risk factors were still prevalent in Turkish population, and these factors led to much higher IHD mortality rates compared to European countries, and this analysis was confirmed with our study. These results are very important as they reflect the awareness of our country's cardiovascular risk factors and mediate the measures planned to be taken in the future against IHD, which is still the most common cause of death in our country.

In the 2010 reanalysis of the TEKHARF cohort by Onat et al,[26] there was no significant difference between regions, but it was reported that the incidence of age-adjusted IHD was higher in men in the Black Sea and Marmara regions. On the contrary, when 12 regions separated by population were evaluated in our study, it was seen that there were significant differences between them. While there is a downward trend in the AAPC value for both genders in the Istanbul region, the fact that this value is still significantly high in the West Marmara constitutes one of the most important examples of regional changes. Looking at the 2011 data of the risk factors frequency study conducted in our country, it is seen that the region with the highest prevalence of hypertension, uncontrolled diabetes, and obesity is West Marmara. The higher incidence of these risk factors in Western Marmara may have increased the incidence of IHD mortality in this region.[27] In the other evaluation made in terms of gender, it was found that while IHD mortality was 1.95 times higher in men throughout the country, this rate was higher (2.61 times) in the Istanbul region. In both the 2011 and 2017 chronic diseases and risk factors prevalence reports, it is seen that tobacco use is significantly higher in males (43%) than in females (17%-19.7%), and in the same study, there is not such a big difference between the genders in the prevalence of other risk factors. We think that this explains the main reason for the increase in favor of males in IHD mortality rates in our country.[27,28] In addition, when the Istanbul region is evaluated, both smoking and high triglyceride levels, as well as the fact that overweight and obese male individuals are more common in Istanbul compared to other regions explain this high rate in men.[27] Furthermore, there was a significant increase in men in the Western Marmara and Southeastern Anatolia regions between 2009 and 2015, and a significant increase was observed in both genders in the Aegean region. In the 2011 risk factor study that sheds light on the same period, we think that the higher prevalence of many risk factors such as smoking, alcohol consumption, and obesity in Western Marmara and Aegean may have led to these results. Apart from these results, many data were presented in our study according to periodical, regional, gender, and age ranges. A more detailed examination of these results is needed. Especially in the 2015-2019 period, the decrease in regular APC rates seen in most regions is probably the result of better control of social risk factors, improvements in health care, developing stent technologies, increasing coronary angiography laboratories, and policies implemented in line with the Ministry of Health's 2015-2020 cardiovascular disease prevention control program.[29]

Limitations

Although the results of this study were obtained by using the official data of the relevant ministries, they may contain individual data entry errors. In our country, the sensitivity of physicians and the control of causes of death in many different steps increase the reliability of our data. We think that possible individual errors are not large enough to affect the results. During the period evaluated by the study, the death notification system was changed by the relevant ministry in 2013, and the collection of data was transferred to the digital environment. In our study, it is seen that ASR rates increased in 2013 compared to previous years. We think that there is a possibility that this situation will lead to ASR rates increased in 2013 compared to previous years. During the period of our study, ICD-10 diagnostic codes were used in our country; therefore, this situation had no effect on our results.

Conclusion

In the 2009-2019 IHD mortality trend study, although the mean age standard rate was positive for both sexes, significant differences were observed periodically. In our study, we determined that the IHD mortality rate was significantly higher in men than in women. There were significant breaks in the regional assessment in different time periods. We also determined significant reductions in IHD mortality during the 2015-2019 period. The data of our study may enable the identification of the priority risk factors for IHD mortality reduction, the correct direction of financial resources, and the production of evidence-based policies. This study is important in that it is the first study to examine the IHD mortality trend in Turkey in terms of regional, gender, and different age groups. It also provides important evidence for future research.

Availability of Data and Material: The data sets used and analyzed during the current study are available from the corresponding author on reasonable request.

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